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NOTES ON GEOGRAPHIC DISTRIBUTION

The first record of the European land snail *Discus rotundatus* (Müller, 1774) from Montreal, Canada (Discidae: Pulmonata)

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ABSTRACT: Comparison of the shells of a land snail collected in Montreal, Canada with those of several North American and European *Discus* species resulted in the identification of the Montreal specimens as the European *Discus rotundatus*.

Discus rotundatus (Müller, 1774), a native land snail of Europe, has been introduced to several locations in North America (Dundee 1974; Roth and Sadeghian 2006). The earliest North American records are from Massachusetts and date to the 1930s (Pilsbry 1948). According to the most recent compilation of the terrestrial gastropods of Canada, *D. rotundatus* has been recorded in Ottawa, Toronto, Newfoundland and "possibly Montreal" (Grimm *et al*. 2009). The tentative record from Montreal was based on the specimens I had collected in July 2008 and provisionally identified as *D. rotundatus* (R. Forsyth, pers. comm.). The uncertainty about the identity of the Montreal specimens arose because they mostly lacked the characteristic reddish marks of *D. rotundatus* (Figure 1). To ascertain the identity of the Montreal *Discus*, I collected additional shells from the same location in August 2011 and carried out a conchological comparison of the Montreal specimens with the shells of several North American and European *Discus* species. The results are presented here.

The collection location in Montreal was in the woods by the road just below the landmark known as La croix du Mont Royal on Mont Royal (45°30'30" N, 73°35'17" W). I compared five shells from Montreal collected in 2008 and 2011 with the stated number of shells, usually the largest ones, in the following lots of *Discus* species from the Delaware Museum of Natural History, Wilmington, Delaware, USA (DMNH) and the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA (CMNH).

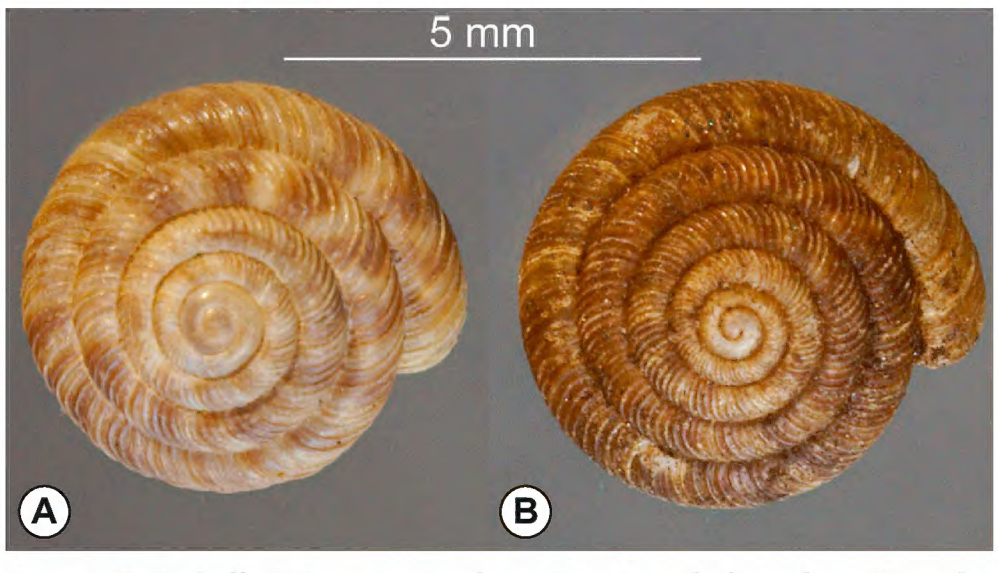

FIGURE 1. A shell of *Discus rotundatus* from Istanbul, Turkey (A) and a shell from Montreal, Canada identified as the same species in this study (B).

Discus catskillensis (Pilsbry, 1896): DMNH 165526, Maine, USA, 2 shells; CMNH 66577, Michigan, USA, 4 shells.

Discus patulus (Deshayes, 1830): DMNH 171543, Tennessee, USA, 4 shells; CMNH 62.35189, West Virginia, USA, 4 shells.

Discus rotundatus: DMNH 128275, Sweden, 4 shells; DMNH 129270, Long Island, USA, 3 shells; CMNH 62.26616, Stein am Rhein, Switzerland, 5 shells.

Discus ruderatus (Férussac, 1821): CMNH 62.20365, Grisons, Switzerland, 3 shells; CMNH 62.9595, Cluj (Klausenburg), Romania, 4 shells.

Discus whitneyi (Newcomb, 1864): DMNH 171531, British Columbia, Canada, 5 shells; CMNH 62.39288, Pennsylvania, USA, 5 shells.

I selected these species, because *Discus catskillensis, D. patulus* and *D. whitneyi* are native and *D. rotundatus* is introduced to eastern Canada, while *D. ruderatus* is a European species that is similar to *D. rotundatus* in shell shape, but without the shell markings of it. I excluded the third European species, *D. perspectivus* (Mühlfeld, 1816), from this study, because it is easily distinguished from the other species by its flat and sharply keeled shell. I did not attempt to confirm the identifications of the museum lots of *D. catskillensis* and *D. whitneyi*, because, as Pilsbry (1948) noted, the two species may not always be distinguishable from each other. In any case, the misidentification of one species as the other would not have changed the conclusion of this study. Additionally, I used from my personal collection three *D. rotundatus* shells from Istanbul, Turkey (Örstan 2003; Örstan and Kösemen 2011) and one *D. patulus* shell from Garrett

County, Maryland, USA. I deposited the *Discus* shells from Montreal collected in 2011 in the CMNH (118700).

I measured the following variables for each shell (Figure 2): maximum shell diameter (SD), umbilicus diameter (UD), diameter of the first two whorls (D2), diameter of the first three whorls (D3), number of whorls (NW) and the number of ribs in the last quarter of the penultimate whorl (NR). I counted NW along the suture and counted NR and measured UD, D2 and D3 under a dissecting microscope using a calibrated eyepiece reticle. The UD was measured from the attachment point of the inner edge of the lip across the umbilicus to the opposite side. The plotting was done using PAST (Hammer and Harper 2011).

I constructed bivariate plots of various combinations of the measured variables and evaluated them visually. The plots of D3 against SD, NW or UD and NW against SD or UD separated the data points into three groups. The first group contained only the points for *Discus patulus*, the second group contained the points for *D. catskillensis, D. whitneyi* and *D. ruderatus* and the third group contained the points for *D. rotundatus* and the Montreal specimens. The 95% confidence ellipses for the combined points in each group did not overlap. Representative plots are in Figure 3. The same three groups were also obtained in the plot of D2 against SD, but the 95% confidence ellipses for the second and the third groups overlapped. The plot of UD against SD was approximately linear and separated only the points for *D. patulus* into a distinct group, primarily because the shell diameters of the latter species are much larger than those of the rest. The NR were too variable to be of taxonomic value.

These results demonstrate that the Montreal specimens cannot be distinguished from *Discus rotundatus* using the variables measured in this study. Therefore, I now identify the Montreal specimens conclusively as *D. rotundatus*. Taylor (1914) noted that the reddish marks were occasionally wanting on *D. rotundatus* shells. Their lack on the Montreal specimens is, therefore, not unusual. I observed live *Discus* at the Montreal site in 2008, but found only empty, fresh shells in 2011. The observations of the species at the same location three years apart strongly indicate the presence of a stable colony. Casual searches at a few locations elsewhere on Mont Royal did not reveal other colonies of *D. rotundatus*.

The results also demonstrate that *Discus catskillensis, D. whitneyi* and *D. ruderatus* cannot be separated from each other using the conchological characteristics used in this study. Umiński (1962) also noted that the shells of *D. ruderatus* could not be distinguished from specimens classified as *D. cronkhitei* (Newcomb, 1865), a junior synonym of *D. whitneyi* (Roth 1987). A more detailed comparison of these three species is outside the scope of the present study.

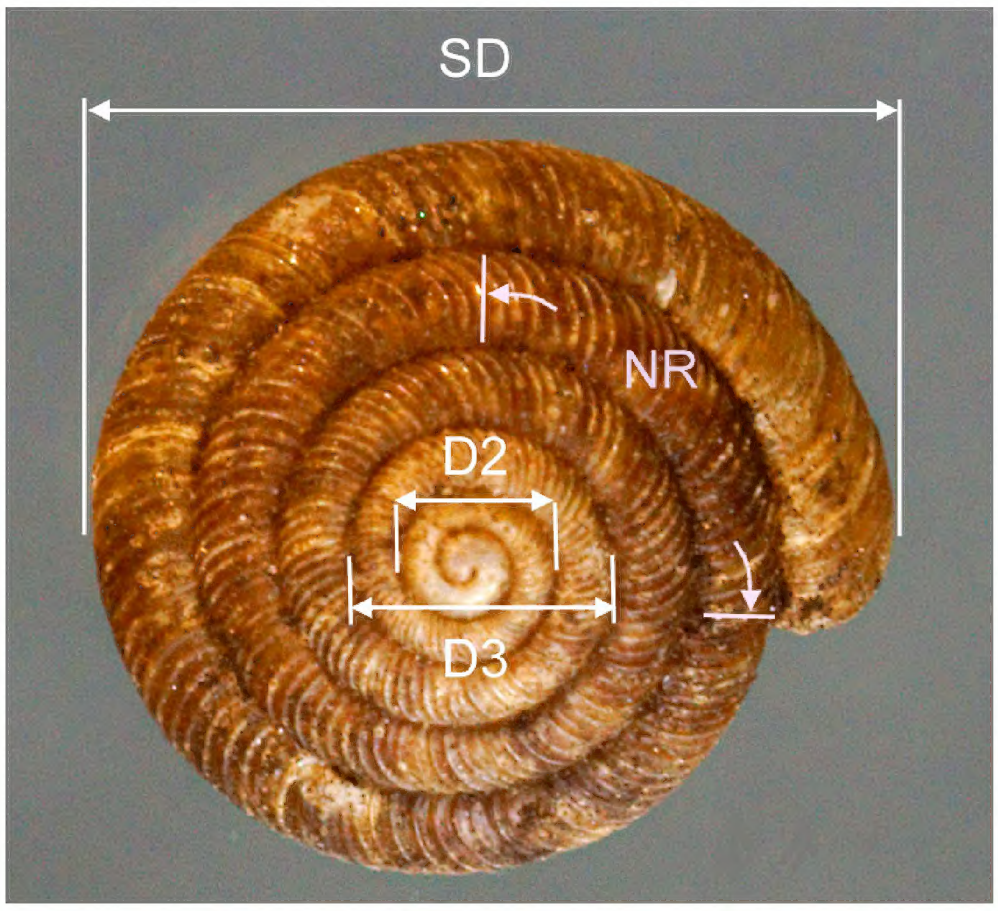

Figure 2. Four of the six variables measured on each shell. Whorls were counted along the suture: this shell had six.

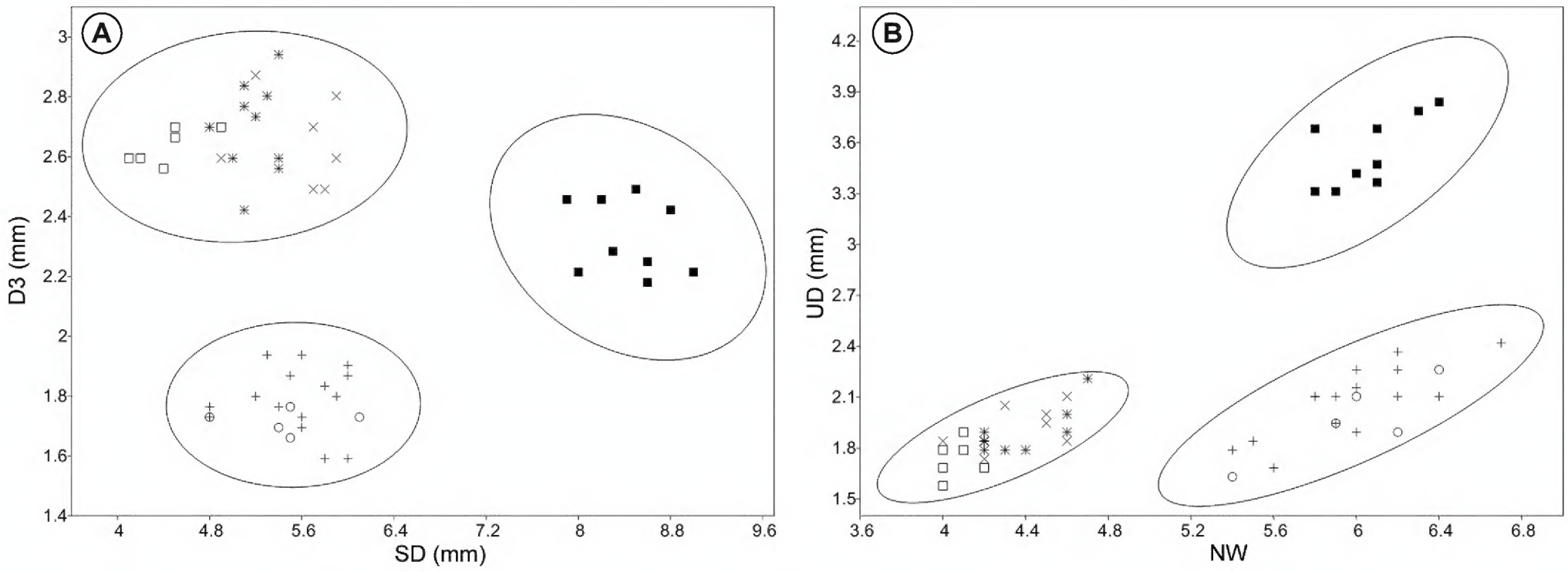

Figure 3. A) Bivariate plot of the diameter of the first three whorls (D3) against the maximum shell diameter (SD) for: *Discus catskillensis* (open squares), *D. ruderatus* (x), *Discus whitneyi* (asterisks), *D. patulus* (filled squares), *D. rotundatus* (+) and the Montreal specimens (open circles). B) Bivariate plot of the umbilicus diameter (UD) against the number of whorls (NW). Symbols are as in Figure 3A. For both plots the 95% confidence ellipses are for the combined points in each group.

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